Stoller
Hanford Office

DOE-EM/GJ1265-2006

299-W18-69 (A7552)
Log Data Report

Borehole Information:

Borehole: 299-W18-69 (A7552)			Site: 216-Z-12 Crib		
Coordinates (WA St Plane)		GWL[1] (ft) : None		GWL Date: 01/03/06	
North (m)	East (m)	Drill Date	Ground Level Elevation	Total Depth (ft)	Type
135453.431	566352.299	01/67	686.33	280.0	Cable

Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Steel	1.15	6 5/8	6 1/16	9/32	+1.15	77

Borehole Notes:

The logging engineer measured the casing stick-up and diameter using a caliper and steel tape. Logging data acquisition is referenced to the TOC.

Logging Equipment Information:

Logging System:	Gamma 4N		Type:	SGLS (70%) SN: 45TP22010A
Effective Calibration Date:	08/03/05	Calibration Reference:	DOE-EM/GJ953-2005	
		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Logging System:	Gamma 4I		Type:	Passive Neutron U1754
Calibration Date:	None	Calibration Reference:	None	
Calibration not required		Logging Procedure:	MAC-HGLP 1.6.5, Rev. 0	

Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3 Repeat		
Date	01/09/06	01/12/06	01/12/06		
Logging Engineer	Spatz	Spatz	Spatz		
Start Depth (ft)	76.5	15.5	27.5		
Finish Depth (ft)	14.5	1.5	27.5		
Count Time (sec)	200	200	1000		
Live/Real	R	R	R		
Shield (Y/N)	N	N	N		
MSA Interval (ft)	1.0	1.0	1.0		

Log Run	1	2	3 Repeat		
ft/min	N/A[2]	N/A	N/A		
Pre-Verification	DN111CAB	DN121CAB	DN121CAB		
Start File	DN111000	DN121000	DN121015		
Finish File	DN111062	DN121014	DN121015		
Post-Verification	DN111CAA	DN121CAA	DN121CAA		
Depth Return Error (in.)	0	0	0		
Comments	No fine-gain adjustment.	No fine-gain adjustment.	No fine-gain adjustment.		

Passive Neutron Logging System (PNLS) Log Run Information:

Log Run	4	5 Repeat			
Date	01/12/06	01/12/06			
Logging Engineer	Spatz	Spatz			
Start Depth (ft)	76.5	29.5			
Finish Depth (ft)	1.5	23.5			
Count Time (sec)	N/A	N/A			
Live/Real	R	R			
Shield (Y/N)	N	N			
Sample Interval (ft)	1.0	1.0			
Log speed (ft/min)	1.0	1.0			
Pre-Verification	DI292CAB	DI292CAB			
Start File	DI292000	DI292076			
Finish File	DI292075	DI292082			
Post-Verification	DI292CAA	DI292CAA			
Depth Return Error (in.)	0	0			
Comments	None	None			

Logging Operation Notes:

Logging was conducted with a centralizer on the sonde and measurements are referenced to top of casing. A spectrum was acquired at 1000 second counting time at 27.5 ft to further evaluate the depth where highest gamma activity was observed.

Passive neutron logging was also performed in the borehole. This logging method has been shown to be effective in qualitatively detecting zones of alpha-emitting contaminants from secondary neutron flux generated by the (α,n) reaction and may indicate the presence of transuranic radionuclides.

Analysis Notes:

Analyst:	Henwood	**Date:**	07/06/06	**Reference:**	GJO-HGLP 1.6.3, Rev. 0

Pre-run and post-run verifications for the SGLS were performed before and after each day's data acquisition. The acceptance criteria were met.

An AmBe neutron source was used for verification measurements with the passive neutron logging system. Currently there are no verification criteria established for this system. The counts obtained from the pre and post verifications were within 1 percent.

A casing correction for 9/32-in.-thick casing was applied throughout the borehole.

SGLS spectra were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Concentrations were calculated with an EXCEL worksheet template identified as G4NAug05.xls using an efficiency function and corrections for casing and dead time as determined from annual calibrations.

Results and Interpretations:

There is a presumption that the waste stream at the 216-Z-12 crib will contain only transuranic radionuclides (e.g., ^{239}Pu, ^{241}Am, and ^{237}Np). Fission products such as ^{137}Cs have been removed prior to the final plutonium refinement at the Plutonium Finishing Plant (PFP) where the 216-Z-12 crib waste stream originated. ^{137}Cs emits a 661.66 gamma ray that cannot be distinguished from a 662.40 gamma ray emitted from ^{241}Am. A corroborating energy peak at 722.01 keV is used to establish the presence of ^{241}Am rather than ^{137}Cs. In this borehole it is interpreted that the 662 keV energy peak is the result of ^{137}Cs because of the lack of the corroborating 722.01 keV energy peak and the location and depth where the energy peak is detected. This borehole is located in the western edge of the inward sloping excavation of the crib, approximately 30 ft west of the centerline of the crib. The bottom of the waste distribution pipe in the center of the crib is approximately 17 ft below ground surface (18 ft from the top of casing). The most intense 662 keV energy peaks are detected between 9 and 14 ft, well above this depth, apparently in native soil or backfill material, which suggests that the contamination represented by the 662 keV peak originated from a source other than the distribution pipe. It is interpreted as ^{137}Cs, with a maximum concentration of approximately 1 pCi/g. ^{137}Cs is detected at sporadic locations between 14 and 22 ft at concentrations near the MDL of approximately 0.15 pCi/g.

^{237}Np is detected with the SGLS by measuring a daughter product (protactinium-233 (^{233}Pa)) that emits relatively prominent gamma rays at energy peaks of 300.34, 312.17, 340.81, 375.45, 398.62, and 415.76 keV. The "^{233}Pa Energy Peak Comparison" plot indicates concentrations determined from each of the energy peaks. This plot is instructive to determine if interfering gamma rays from different radionuclides could cause inaccurate assays. For example, ^{239}Pu emits gamma rays at 375.05 and 413.74 keV that cannot be distinguished from the 375.45 and 415.76 gamma rays emitted by ^{233}Pa. ^{241}Am also emits gamma rays at 376.65 and 415.88 keV that could interfere. Because ^{233}Pa, ^{241}Am, and ^{239}Pu are sometimes found together in the PFP waste streams, it is possible all of these radionuclides are contributing gamma rays to the above peaks. However, the concentrations determined for ^{233}Pa using each of the energy peaks yield similar values suggesting there is no significant interference from ^{239}Pu or ^{241}Am. (Note: The 375 keV gamma line (51 % error) shows interference at 25.5 ft. This could indicate ^{239}Pu but a full energy peak at 414 keV is not indicated). Further scrutiny of other outliers show peaks in individual spectra have high error (greater than 60%). In the case of the 300.34 keV peak there is an interfering contribution from an energy peak (300.09) from ^{212}Pb which is enhanced in concentration between 24 and 28 ft.). The 312.17 keV gamma line exhibits the highest yield (38.6 %) and is used to determine the concentration for ^{233}Pa. ^{233}Pa was detected between 23 and 44 ft. The maximum concentration is 22 pCi/g at 26.5 ft in depth.

A slightly elevated ^{232}Th concentration as determined using the 2615 keV (^{208}Tl) energy peak is indicated between 24 and 28 ft. Both ^{232}U and ^{232}Th decay to ^{228}Th, the first decay product of ^{232}U and the third decay product of ^{232}Th. Therefore, the concentration determined for each decay product from ^{228}Th to ^{208}Tl will reflect decay from both parents. In spectral gamma log analysis, the 2615 keV ^{208}Tl gamma ray is used to represent the concentration of the naturally occurring parent ^{232}Th. This gamma ray is energetic relative to gammas emitted by the other daughter products and its yield of approximately 35% results in easy detection. However, because the decay chain of naturally occurring ^{232}Th is modified by the emergence of the decay products of ^{232}U, the natural component of ^{232}Th must be determined from its second decay product (^{228}Ac). ^{228}Ac can be directly measured using the 911 keV gamma ray. The plot of natural gamma logs shows the disruption of the equilibrium (i.e., separation of the 911 and 2615 keV assays) of the natural ^{232}Th decay, where between 24 and 28 ft the ^{228}Ac indicates ^{232}Th concentrations below that calculated from the 2615 keV gamma line.

To determine the concentration of ^{232}U, the activity due to natural decay of ^{232}Th, must be subtracted. The ^{228}Ac concentration is subtracted from the ^{232}Th concentration calculated based on the 2615 keV ^{208}Tl

energy peak. The result is a maximum concentration of approximately 0.3 pCi/g ^{232}U. For the naturally occurring ^{232}Th, the 2615 keV peak is used to calculate concentrations except for the interval from 24 to 28 ft where ^{228}Ac is used.

^{233}U almost certainly exists where ^{232}U is detected. In a reactor using thorium target material, ^{233}U will be generated at roughly three orders of magnitude more than ^{232}U. However, at relatively low concentrations, ^{233}U does not emit a gamma ray that can be detected with the SGLS and decay products that potentially could be measured have not had sufficient time to build in to detectable levels. It is inferred on the basis of the ^{232}U concentration that approximately 30 to 300 pCi/g ^{233}U may exist in this waste stream.

The passive neutron log data indicate no significant neutron flux that would suggest the existence of plutonium isotopes or ^{241}Am.

Spectral gamma data were acquired in this borehole in 1993 by Westinghouse Hanford Company using the Radionuclide Logging System (RLS). A comparison plot of the RLS (1993) and SGLS (2006) manmade radionuclides show similar concentration profiles for ^{137}Cs and ^{233}Pa, suggesting no changes since 1993. Data analysis for the 1993 data did not identify ^{232}U or ^{233}U as potential contaminants.

Historical total gamma log data acquired in 1967 and 1968 indicate contamination existed at the same approximate depth (24 ft) in February 1967 (Fecht et al, 1977).

List of Log Plots:

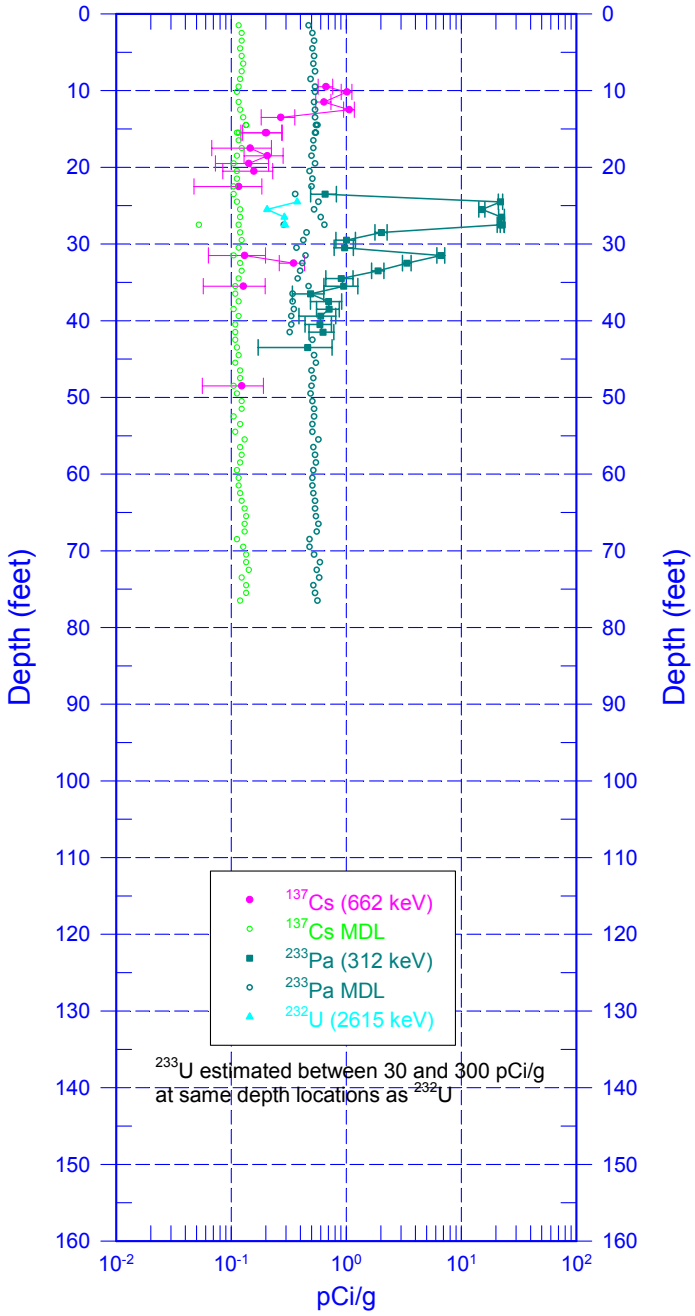
Man-Made Radionuclides
Natural Gamma Logs
Combination Plot
Total Gamma & Dead Time
^{233}Pa Energy Peak Comparison
Comparison of RLS (1993) and SGLS (2006)

References:

Fecht, K.R., G.V Last, and K.R. Price, 1977. *Evaluation of Scintillation Probe Profiles from 200 Area Crib Monitoring Wells*, ARH-ST-156, Atlantic Richfield Hanford Company, Richland, Washington.

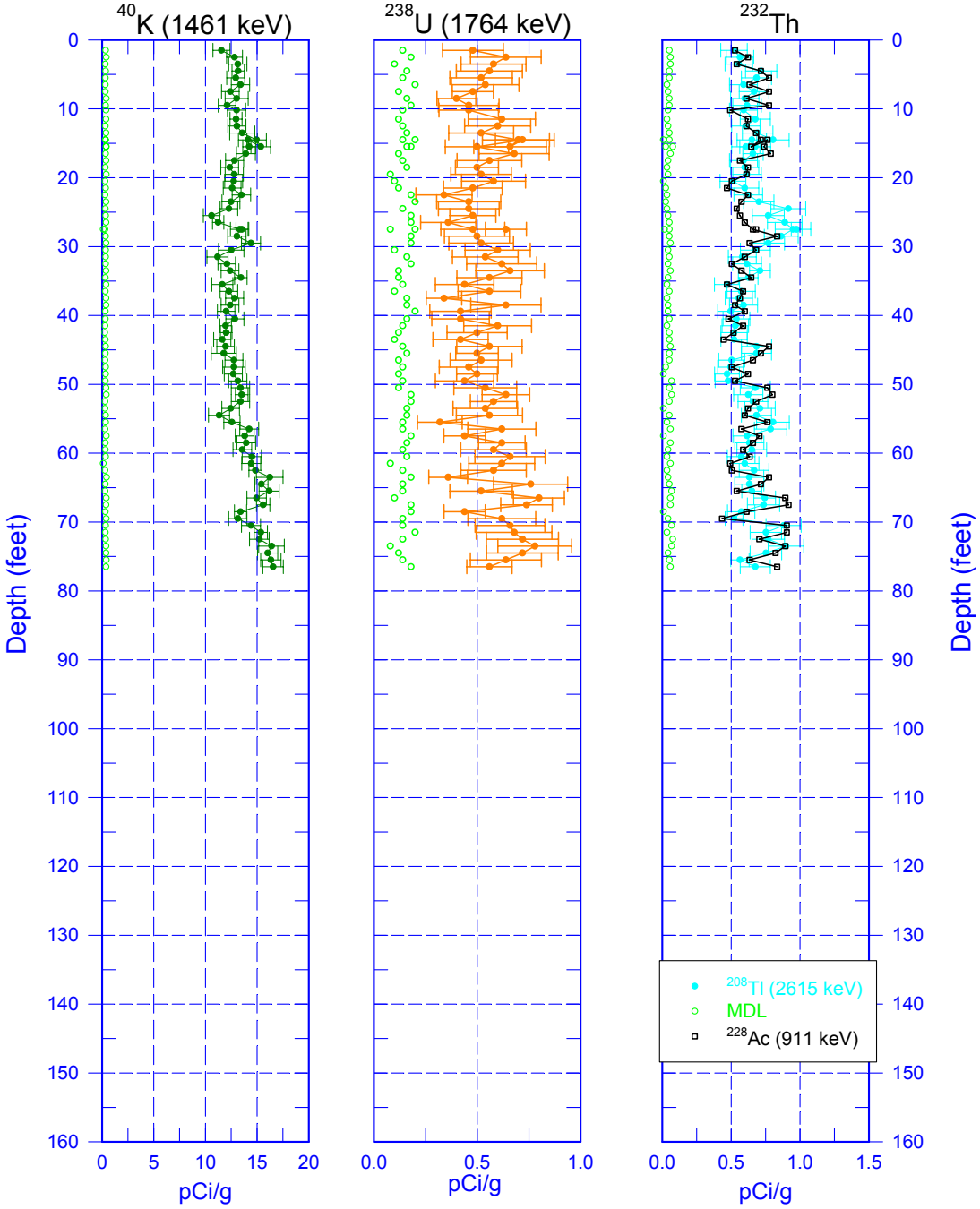
[1] GWL – groundwater level
[2] N/A – not applicable

299-W18-69 (A7552)
Man-Made Radionuclides



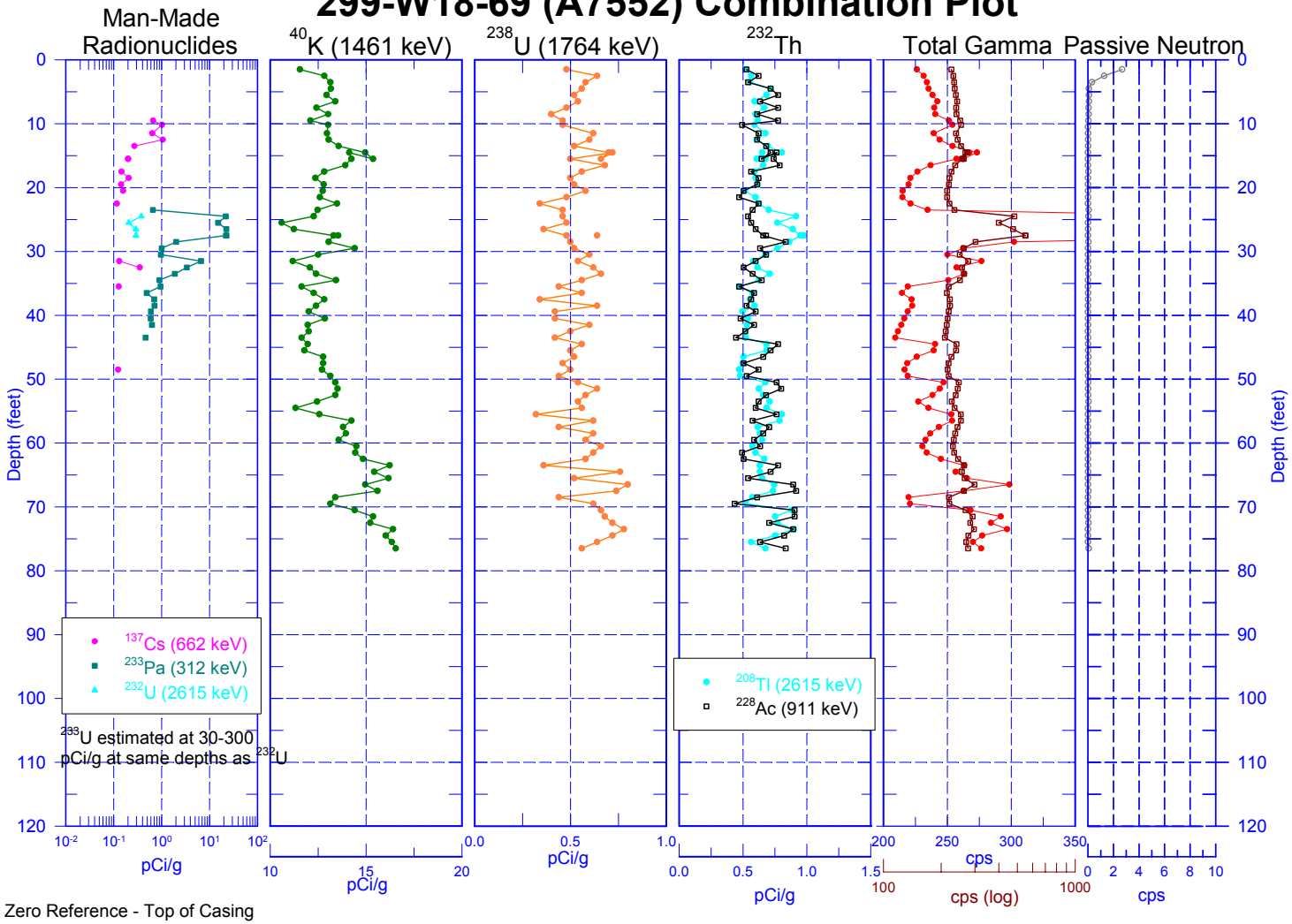
Zero Reference - Top of Casing

299-W18-69 (A7552)
Natural Gamma Logs



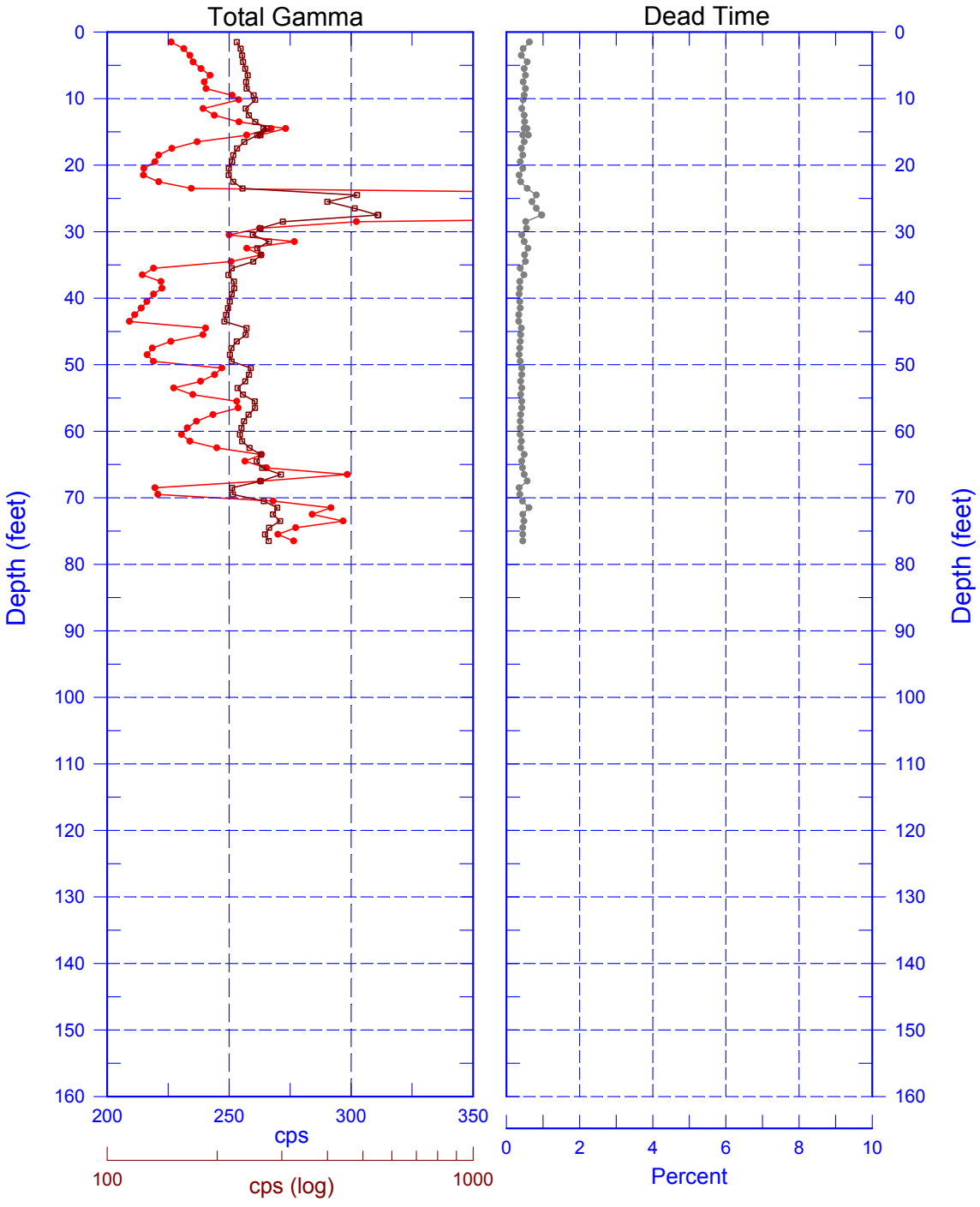
Zero Reference = Top of Casing

299-W18-69 (A7552) Combination Plot



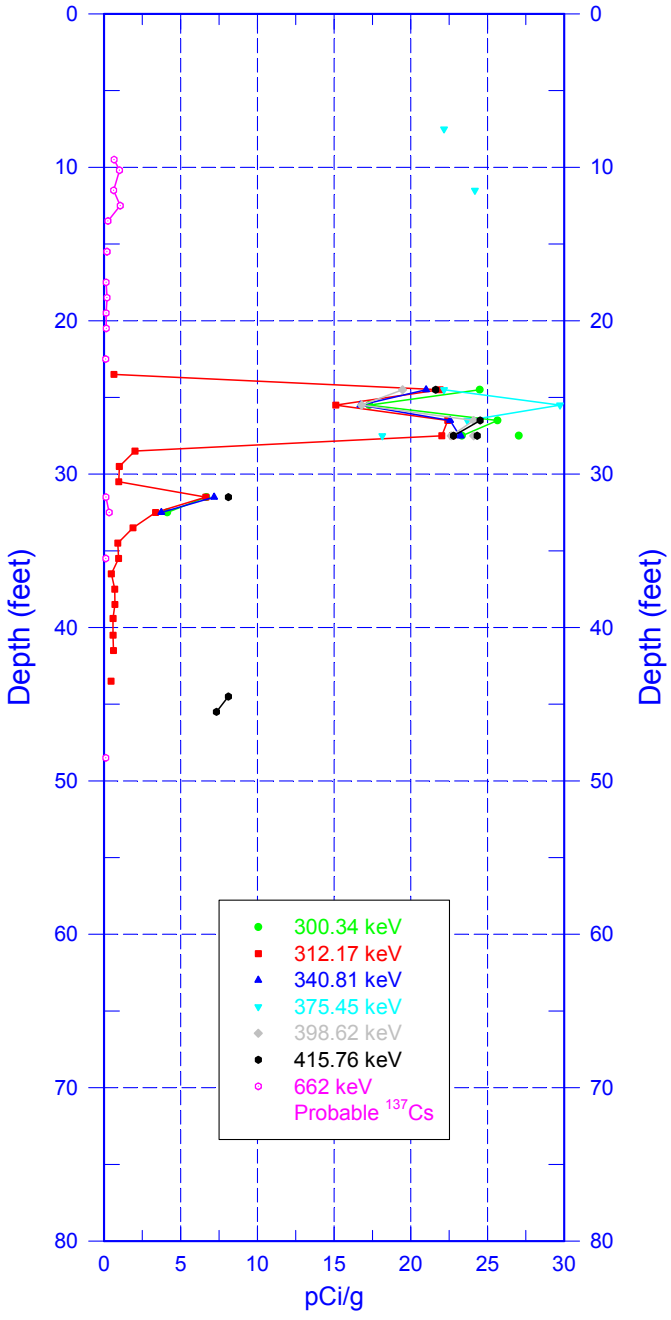
Zero Reference - Top of Casing

299-W18-69 (A7552)
Total Gamma & Dead Time



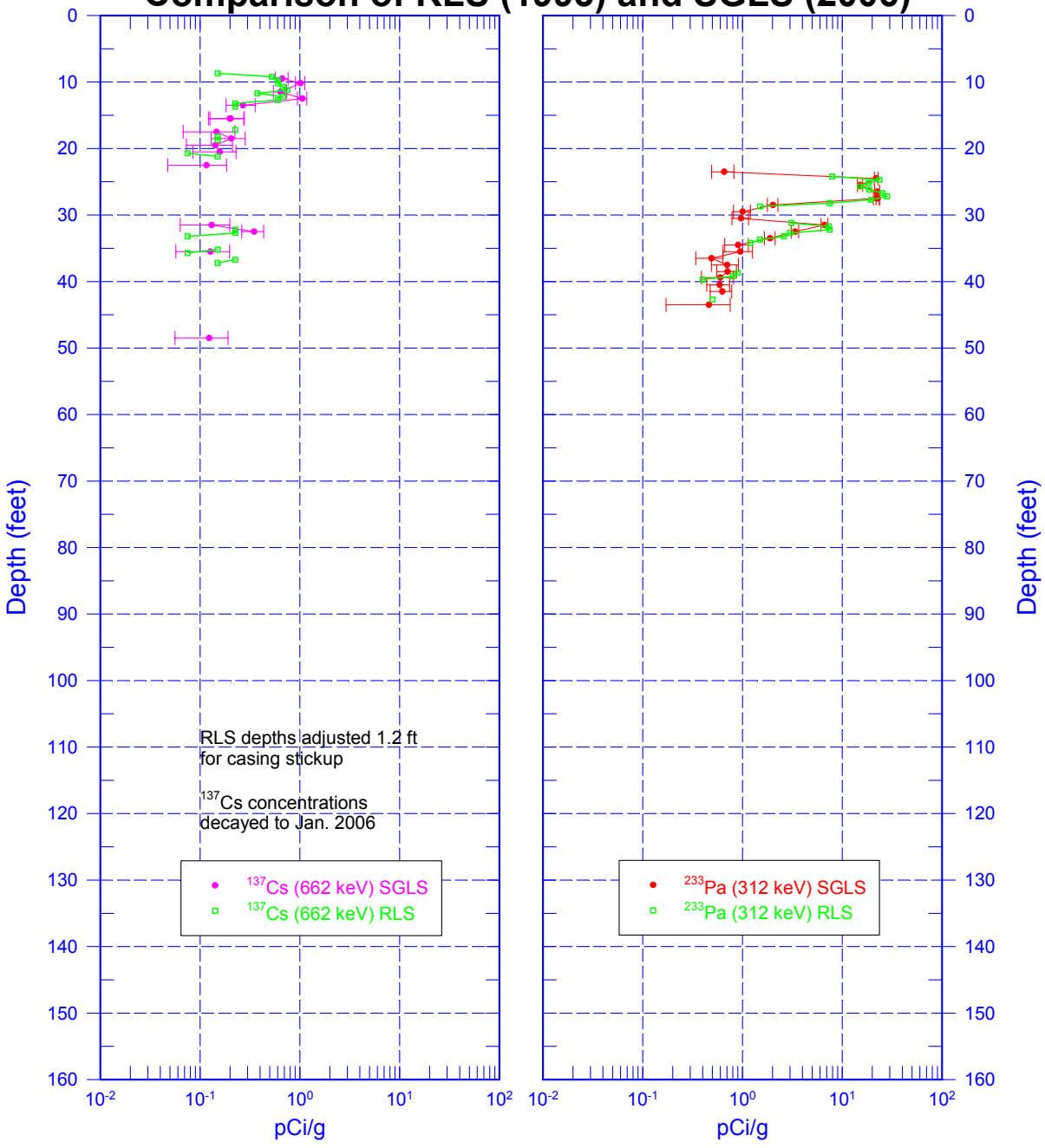
Reference - Top of Casing

299-W18-69 (A7552)
^{233}Pa Energy Peak Comparison



Zero Reference - Top of Casing

299-W18-69 (A7552)
Comparison of RLS (1993) and SGLS (2006)



Zero Reference - Top of Casing